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# **TØI's research activities within EU's Framework Programmes**

**Results from projects with participation from TØI  
1996-2000**

**Editor: Olav Eidhammer**

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From 1996 to 2000 was TØI participating in 14 projects with full or partly financing from EU's 4th Framework Programme. The report presents summaries from these projects. For each of the projects this report presents objectives, methods, results and references to main documentation as reports, papers and articles.

**Titel:** TØIs forskningsaktiviteter i EU's rammeprogrammer. Resultater fra prosjekter med deltakelse fra TØI 1996 - 2000

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I perioden 1996-2000 deltok TØI i 14 prosjekter med full eller delvis finansiering fra EUs 4. rammeprogram. Denne rapporten gir en oppsummering av de viktigste resultater og funn fra disse prosjektene. For hvert av prosjektene er det lagt vekt på å få fram problemstillinger, metode, resultater og dokumentasjon i form av rapporter, "papers" og artikler.

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# Preface

This report presents the summaries from projects worked out under EU's 4<sup>th</sup> Framework Programme with participation from The Institute of Transport Economics (TØI). The projects are either fully or partly financed by EU.

The activity at TØI under EU's 4<sup>th</sup> Framework Programme consists of deliverables to 14 projects. In this report the project summaries from these projects are organized in five areas: Public transport (3 projects), Cost benefit analysis (3 projects), Freight transport (1 project), Strategic research (5 projects) and Traffic safety (2 projects).

For each project the report presents formal information as project number, who commissioned the projects, lead partner, partners and project leader at TØI. The report summaries consist of objectives, methods, results and findings, main reports, papers and articles. Further information from the projects could be obtained from the project leaders at TØI or <http://www.cordis.lu/transport/-5rc/project.htm>.

Authors of the summaries are the project leaders at TØI. Olav Eidhammer has been project leader and editor of the report and Laila Aastorp Andersen is responsible for the lay-out.

The report is financed by TØI.

Oslo, July 2001  
Institute of Transport Economics

*Knut Østmoe*  
Managing director



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# **Public transport**





## ISOTOPE

# Improved Structure and Organisation for urban Transport Operations and Passengers in Europe

### Information on the Project

**Project No:** 2203

**Commissioned by:** DG VII

**Lead partner:** TIS- Transportes Inovação e Sistemas a.c.e., Lisbon, Portugal

OGM- Organisation Gestion Marketing s.a., Brussels, Belgium

**Other full partners:** CERTU (F), UTP (F), ITS (UK)

**Associated partners:** STIB (BE), VTI(S), GART (F), HFA (UK), STUVA (DE), NEA (NL), INECO (ES), GMPTE (UK), SIKa (S), TØI (N), Trans-Por (PT), ERASMUS (NL), University of Stockholm (S)

**Project manager at TØI:** Kjell Werner Johansen

## Summary

### Objectives

The stated objectives of the ISOTOPE project were:

- To describe and compare existing legal status and organisational structures for public urban transport operations in urban areas in the European countries, and to analyse the pros and the cons of those forms in terms of effectiveness and efficiency
- To provide a strategic approach to the development of urban public transport operations to political decisions-makers, transport planning authorities, public transport authorities and operators; this appraisal will identify how organisational structures may be improved, respecting the political, legal and doctrinal frameworks of each country, in order to determine the role of public transport in European urban areas.

## **Main notes**

The approach chosen to undertake this study divided the analytical part of the research in two parts: Economic and Political research.

In the Political research the aim was to identify the various existing organisational structures and legal frameworks and evaluate their effectiveness and appropriateness from both the social and political points of view, as well as the capacity of the existing systems to contribute to the strategic objectives of the internal market and converge towards the main European orientations.

In the Economic research the aim was to evaluate the efficiency of the different organisational systems in both demand and supply side perspectives, through the identification of variables and criteria that will allow to establish significant relationships between objective variables reflecting efficiency in production in one hand and the ones reflecting efficiency in consumption in the other hand.

To support the survey a two-parts questionnaire was created and addressed to the Authorities and Operators of the cities surveyed:

Factual questionnaire - Covering the system description and economic and financial aspects, these last ones mainly conceived to produce inputs to the Economic research;

Opinion questionnaire - Covering the different aspects of the relationship between Authorities and Operators, as well as the evolution of the systems in time considering their legal, regulatory and political aspects. This questionnaire was dedicated to produce inputs to the Political research.

## **Main results and conclusions**

**The Political Research** addressed the following areas:

- Categorisation of political choices, legal status and organisational structures.
- Detection of potential conflicts in each category.
- Analysis of historical tensions and evolution in each category.
- Strategic evaluation - threats and opportunities, strong and weak points and innovative practices.

The research identified three main categories of legal frameworks for urban public transport:

- Regulated, publicly owned monopolies (« the classical model »). This is the dominant organisational form in 10 member states (AT, BE, DE, ES, LU, GR, IT, NL, PT), although there may in these states be some cities that have variations on this regulatory structure (e.g. regulated, private monopoly) or may have an alternative regulatory structure (e.g. some cities in ES have network management contracts).
- Limited Competition Models. This has a number of variants. The two most common are the Scandinavian model, based on minimum cost tenders at a route level and

represented in three member states (DK, FI, SE), with a variant also in Norway, and the French model, based on network management contracts, which is common in FR.

- Deregulated, Free Market Models. This is the dominant form in GB outside London. In London, route based tendering has been implemented.

Inside these frameworks, the different forms of organisational systems have been categorised as follows, in relation with the source of the initiative (action of the actor that first proposes, undertakes or organises public transport):

The main conclusions taken from this analysis were:

- UPT performances rely on a framework involving in an appropriate way both authorities and operators. Distinct roles have to be assumed by each of these partners. The user is considered as also having to be involved in the evolution of the UPT system, e.g. in terms of the assessment of UPT performance;
- among the improvements that can be brought to the present situation, we identified the necessity of respecting basic management principles (correct definition of objectives, and existence of assessment procedures for both the authorities and the operators) and the necessity for a more systemic approach of UPT;
- a large majority of respondents expect changes in the near future, in relation with issues which are on the European orientation agenda (green papers on citizens' network, fair and efficient pricing, public procurement); there is undoubtedly a general agreement on the priorities for the coming evolution of UPT system between authorities and operators;
- the level of satisfaction among the different organisational regimes analysed is relatively high, with a higher level of criticism in the «deregulated» regime, and a higher level of expected change in the «regulated» regime;
- in all the different legal frameworks, both the urban authorities in charge of public transport and the operators consider the present system as efficient, effective and appropriate. They accept the fact that external actors, as electors (tax payers), press, mediator or motorcar associations, have a less positive perception of the present situation;
- it appears that the UPT consumers' perception of the situation is more positive in a « limited competitive » regime or in a « regulated » framework.

The objective of the **Economic Research** work was to apply economic analysis to urban public transport, at both a theoretical and an empirical level, in order to assess efficiency in terms of both production and consumption. Our study is the first attempt to look systematically at this issue for urban transport at the European level. In so doing we aim to identify the organisational and regulatory features of systems that are efficient in both production and consumption.

The main conclusions taken from the economic research were:

Deregulated markets have theoretical and empirical advantages in terms of efficiency of production. Regulated markets have theoretical and empirical advantages in terms of efficiency in consumption. Limited competition markets may have advantages of both.

Overall, we find some support for the Citizens' Network Green Paper's preference for some form of limited competition model.

However, the main advantage of such models is not "to provide an environment which gives operators an incentive to raise standards whilst safeguarding system integration" (although they can do this) but in increasing efficiency in production whilst maintaining or improving efficiency in consumption. Work in WP3 suggests that in some areas, reductions in unit operating costs of up to 50% are possible. Where redundancies and wage reductions are not possible these reductions will reduce to around 15% but are still likely to be the main gain of introducing competitive tendering to commercialised but publicly owned and/or regulated operations. These cost savings could then be used to improve the quality of public transport services, the quality of other public services or to reduce taxation. In order to make such gains, it may be necessary to restructure the bus industry in many member states and to develop and enforce appropriate competition policy.

It is also worth making a number of points that should be addressed by future researchers. Firstly, our work has been affected by a number of data problems that stem from a lack of consistent data on urban transport operations at a European level. There were a large number of comparability issues that the ISOTOPE database, given its limited resources, was unable to overcome. Given the large amounts of taxpayers money that urban public transport receives it would be in the public interest for a consistent set of data to be collected so that assessments of value for money could be made. Any move to comprehensive competitive tendering would require such a database to be constructed.

Secondly, we have outlined at least three forms of competitive tendering that could be applied to urban public transport. We believe that future work should make a more detailed assessment of these three forms and explore the large number of possible variants. The link between organisational and regulatory structure should be also explored in more detail.

Thirdly, in considering the trade-off between efficiency in production and consumption it is clear that the former is more readily measurable than the latter. This may have resulted in an over emphasis on cost cutting at the expense of quality improvements. Consumer surplus (expressed as per passenger km) might be considered as a possible summary measure of efficiency in consumption.

Based on the work of these WP's, the final part of the project was dedicated to a process of synthesis, during which we tried to develop a structured understanding of the mutual implications of several decision areas, as well as to define a process to present the recommendations deriving from our work.

Since UPT is a durable component of urban life, definitions about its regulatory system must consider not only matters of efficiency in production and consumption, but also the implications of those decisions on the capacity to influence future choices about the evolution of the system itself, arising from the distribution of information and power among the actors (authorities and operators).

To facilitate consideration of all these aspects, the production of recommendations was preceded by a systematic review of the stakeholders in the systems and their goals. Three levels are recognised: policy goals, customers' goals and agents' goals.

The structure used for presentation of the project recommendations is based on the recognition that varying local conditions and constraints will make the best choices

different from one city to another, and tries to successively address all the major regulatory questions of the sector, openly presenting the arguments in favour of each choice.

For an overview of the project recommendations we refer to the executive summary.

The ISOTOPE project was developed with the work of a large consortium of 18 partners during one and half year and had the support of the European Action Team of UITP and ECTMR as members of the Advisory Committee of the project.

A very important and indispensable participation that deserves to be highlighted was received from authorities and operators of 109 European cities who have kindly accepted to answer the questionnaires that supported our survey, some of which have also participated in our working seminars.

The fact that this was a project which had a strong need for discussion and dissemination of ideas and organisational schemes was clearly reflected in the composition of the consortium where the diversity of entities involved enabled the consortium a deep internal discussion of the political and organisational choices in analysis.

The extension of the survey undertaken and consequent work of analysis represented an workload that largely exceeded the initial estimates, and demanded for an intensive dissemination plan which allowed to share and discuss our ideas and conclusions with the "organised world of public transport".

#### **Main reports, papers and articles**

The following steps were included in this dissemination plan:

- Presentation of the project using a common set of slides to the authorities and operators of the countries involved.
- Production and distribution of a presentation booklet.
- Intermediate seminar held in Lisbon (after 10 months work) to present and discuss the data collected in the survey.
- Pre-final seminar held in Dresden to present and discuss the conclusions of the project.
- Production and distribution of a final booklet summarising the main conclusions.
- Final conference held in Amsterdam to present the final report of the project.

The final report from the project was published by Office of Official Publications of the European Communities, Luxembourg 1998.

# QUATTRO

## Quality Approach in Tendering/contracting Urban Public Transport Operations

### Information on the Project

**Project No:** UR-96-SC-1140

**Commissioned by:** Marcel Rommerts

**Lead partner:** O.G.M. (ORGANISATION-GESTION-MARKETING) s.a.(BE)

**Project manager:** TIS

**Other full partners:** NEA, TØI, Calidad Estrategica

**Associated partners:** CERTU, ELT, ERASMUS, FEDERTRASPORTI, IGKM, INECO, ISIS – (IT) LT (FI) Metro de Madrid, SEMITAG, STCP, STIB/MIVB, STUVA, TRANSMAN, UTP

**Project manager at TØI:** Bård Norheim

## Summary

The objectives of Quattro were

- to identify present and emerging practices in terms of urban public transport (UPT) quality management in contracting and tendering, including definition of quality, showing responsibilities, evaluation procedures and their impact on continuous improvement programmes. This also covers practices of interest in terms of tendering, contracting and monitoring UPT.
- to evaluate these practices, and to consider how trends in quality management in other fields than UPT could be implemented in UPT with identification of best practice and well developed total quality management.
- to suggest guidelines to authorities and operators for tendering, contracting and monitoring UPT, with a strong focus on quality.

The geographical scope of Quattro covers the European Union, Norway, Poland, Hungary and Baltic Europe.

## Methods

A broad data collection exercise has been organised by the consortium, in order to:

- *describe* the existing situation in each country covered by Quattro, relative to the level of public transport, as well as quality management practices in general
- *identify* best practice in public transport, and in other sectors
- *assess* the existing situation through a survey completed by 128 operators or authorities from the Union and Norway.

The data-collection phase includes:

- *A literature survey* to identify and collect information either developed by partners or bibliographic references that enable the analysis of different approaches to quality management;
- *National reports* on the different national frameworks for both quality management in general and, in particular, quality approaches in UPT, covering its impact in the selection and contracting and tendering processes;
- *A survey of documents* covering the analysis, identification and description of quality aspects in several classes of document : laws and regulation; tender documents; contract documents; management information systems of authorities and operators; charters; partnership agreements and other relevant documents for the identification of quality management practices in UPT;
- *Quality surveys* to obtain information about the aspects that the different countries, and within each country Authorities and Operators, use to define and monitor quality of service.
- The collection of information on “*Best Practice*” in UPT and in other sectors with the objective of identifying methods and characteristics that were developed in those cases and the assessment of its potential for use in the Urban Public Transport sector;

## Conclusions and Recommendations

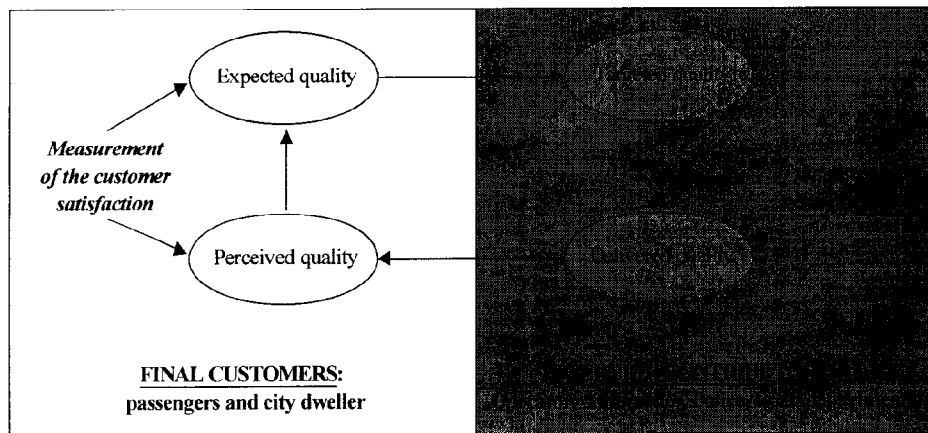
The present position within urban public transport (UPT) reveals a paradox : while the general conditions (congestion, general demand for better conditions of life,...) seem to be in favour of public transport, the market results do not reflect these expectations. It appears that the quality is one of the key dimensions in the provision of UPT that must receive the attention of authorities and operators in charge of public transport. Public transport is a service which the European citizen may decide to use or not. Worldwide service industries now focus on the customer through continuous improvement programmes and customer

satisfaction surveys and UPT should do the same. This will only be successful if the right tools are used by the bodies in charge of public transport planning and operations.

A public transport service quality matrix has developed between Quattro and CEN working team. This quality matrix does not impose a standardised level of attainment but suggests a common approach for quality in urban transport services.

It is recognised that quality in urban transport results from the capacity of the operator to manage and develop its organisation. However it is also the result of the environment in which it operates. These conditions are in the hands of the public authorities in charge of urban planning and traffic management,... The Quattro research has therefore developed a specific quality management tool, “the UPT quality loop”. Just as the quality matrix is a reference for quality definition, the quality loop is a reference for UPT management logic.

Graph 1 : The quality loop at the level of the public transport system



Source : AFNOR

- *Expected Quality*  
This is the level of quality demanded by the customer and it can be defined in terms of explicit and implicit expectations.
- *Targeted quality*  
This is the level of quality that the undertaking aims to provide for its passengers. It is dependent on the level of quality expected by the passengers, external and internal pressures, and budgetary constraints and competitor/market performance.
- *Delivered Quality*  
This is the level of quality that is achieved on a day-to-day basis in normal operating conditions. Disruptions to service, whether they are the fault of the undertaking or not, are taken into consideration.
- *Perceived Quality*  
This is the level of quality perceived, as far as possible objectively, by passengers during their journeys.



This loop is an “holographic” tool : it may be used at the level of the urban area, covering all public transport systems (multi-authorities, multi-operators). On the other hand, it can be used as a management tool, at the level of one route/line or one depot. It can become a corner stone of the European standard for quality in collective passenger transport. Besides these two “fundamental” tenets, Quattro recommend the use of complementary quality tools, for example :

- Revealed preference methods
- Stated preference methods
- Hedonic price method
- Human capital value method
- Damage function approach
- Customer charters and guarantees of service
- Partnership agreements
- Quality standards and certification
- Quality contracts
- Quality tenders and evaluation procedures
- Reward / penalty schemes involving operators and authorities
- Benchmarking (KPIs)
- Customer satisfaction index (CSI)

The challenge now is to design “quality tenders” and “quality contracts” in terms of best practice. Quattro has analysed many existing practices in UPT tenders and contracts. They have been assessed and specific recommendations in the form of a practical guide have been produced by Quattro.

The life cycle for a tendering procedure is reviewed. It explains the meaning and gives practical examples of various elements in the tendering procedure as follows:

- the tender invitation document, including methods for preselection and prequalification
- the bid or tender document prepared by the operators and bidders
- procedures for evaluation and the award of contracts, including such aspects as non compliant bids and negotiation processes
- the contract and contract documents and the administrative and review procedures associated with them

The focus is on the use of quality in all these stages, including the link to quality management principles. The whole process of tendering itself must be regarded as a process where quality principles must be applied. One of these aspects is the consideration of the interests of all stakeholders as part of the selection process.

As a first stage, Quattro analysed where UPT sector stands, in levels of quality management, compared to other industries. A 10 year gap appears. This means that public

transport in Europe faces a challenge: to close that gap in a very few years. Quattro has identified “signals” that will encourage a quick recovery:

1. The evolution of the legal and regulatory framework to create more competitive pressure (directly through competitive tendering or indirectly through benchmarking). This trend recognises the importance of good service and good organisation within the usual financial constraints.
2. The numerous success stories of the result of quality management implementation in UPT throughout Europe.
3. The total quality management support organisations, which exist in every country.
4. The action of the EU to favour raising the level of awareness of the public authorities and operators in charge of public transport, traffic management and urban development of the importance of the quality in UPT, and of recognising the right of the citizen to a central place in the system

The specific consideration given to Poland, Baltic States and Hungary has showed the reliance of the concept of quality tendering, quality contracting and the importance of quality management to UPT. These countries are facing a situation where public transport has a high market share, but faces growing competition from the private car. UPT quality management is a tool to promote public transport in these countries in order to meet market challenges and rapid public subsidy reductions.

The Quattro research shows clearly that quality monitoring of UPT is done on a continuous basis by the users. Therefore, the authorities, operators and equipment manufacturers need to have a practical knowledge of the public transport “experience”. Quality contracts and quality tenders must result in a continuous improvement in public transport experiences. This is the basic condition for acquiring a greater market share.

Finally, better performance in public transport relies on the quality of the staff involved in the production of the services, not only staff of the operators but those within authorities who plan and organise public transport. This means that at all levels, the strategy must be to build a learning organisation, where individual capacity to contribute to the general objective is empowered by an enlightened management philosophy. From the bus and train designer to the traffic and the vehicle cleaner, the scope for quality and “value added” in good public transport is wide and growing. The final responsibility for quality and excellence is at the “front line”, but help and empowerment from the “back office” team is essential.



- The dissemination from the consortium includes :
- presentation of the project through an internet site ([www.eur.nl/quattro](http://www.eur.nl/quattro)), hosted by Erasmus University, and regularly updated in order to provide to viewers the latest information on the project
- explanations leaflet disseminated at national level by the partners

- intermediate seminar held in Lyon, after 13.5 months research, to discuss the main issues and provide input for the final report
- production of final report, summarising the research and outlining the conclusions
- workshops specifically dedicated to Baltic and Central Europe, held in Budapest, Warsaw and Tallinn
- final conference in Luxembourg to present the conclusions and recommendations
- presentations by the members of the consortium at national conferences or congresses and papers presented by national public transport sources.

# WALCYNG

## Walking and cycling

### Information on the Project

**Project No:** UR-96-SC.099

**Commissioned by:** Transport Rtd Programme Of The 4<sup>th</sup> Framework Programme

**Lead partner:** Department of Traffic Planning and Engineering, University of Lund, Sweden

**Partners:**

FACTUM Chaloupka, Praschl & Risser OHG

Franco Gnani and Carlo Bonnani

City of Helsinki, City Planning Office

Institute of Transport Economics

Department of Psychology, University of Helsinki

Instituto de Tráfico y Seguridad Vial (INTRAS), University of Valencia

TransportTechnologie-Consult Karlsruhe GmbH

Dutch Pedestrian Association "De Voetgangersvereniging"

Chalmers University of Technology AB (Associated Contractor)

**Project manager at TØI:** Ingunn Stangeby

## Summary

### Objectives

The purpose of WALCYNG is to sort out conditions and measures which may contribute in replacing short car trips with walcyng (walking and cycling). WALCYNG applies a Marketing Model, in our project formalised in four main parts:

1. **Information policy:** One has to collect information about potential and practising customers so that the preconditions for the behaviour they should choose could be made attractive.
2. **Product and distribution policy:** Adequate and attractive technical solutions are worked out, and considered thoroughly so that they will meet customers' and potential customers' needs.

3. **Incentive and pricing policy:** One also has to provide incentives given by the society, institutions, companies, etc., on all levels, both to encourage walking and cycling and to discourage the use of car for short trips.
4. **Communications policy:** Users and potential users have to be informed that their needs and interests are taken into consideration, on the product and distribution side, as well as on the incentive side. The product has to be displayed and has to be given a positive image.

The project outcome aims both at road users who could replace their short car trips, employers who could support and benefit from a modal change among their employees, and authorities and decision makers who can influence on modal split by changing frame conditions.

## **Methods**

A wide range of methods have been used in the different work packages; e.g. literature studies, analysis of travel surveys, round table discussions with experts and laymen, interviews with experts and road users and a Preference Survey.

## **Main results and conclusions**

The conclusions of the work in the frame of WALCYNG are manifold. In the following, the most important aspects that mainly refer to both implementation and further work, including research work, are summarised:

### **1. How to enhance walcyng instead of short car trips?**

This was, in fact, the main goal of the work in WALCYNG. What can be said very shortly is that such an effort demands a multidisciplinary approach where different types of efforts are combined. The “classical” example that reflects this aspect is: If you have good walcyng facilities but the road users do not know or believe this then you will have far from as many walcers as you want to have. If you tell people to walce and even convince them with arguments and good advertising, but if they then come to the conclusion that they were not told the truth, because walcyng facilities were much worse than promised, then this would also deter people from walcyng.

### **2. The function of research in the area**

Research in this area is to a large degree dealing with a societal subject in change, wanting change. Developmental work is therefore badly needed. The attractiveness of walcyng facilities depends on the perspective that the users take. Such a perspective is context related. It depends on the comfort users perceive when they set a certain behaviour, on values that they believe in, on the experienced fairness of the preconditions that are connected to the behaviour etc. All of these variables change over time, due to a change of perspectives which is partly driven by communication in the society; Whether people appreciate to try to change their own behaviour or not depends on how well and honestly they are informed, on how respectfully and consistently they are treated, on how well and convincingly the necessity of a change is explained, on the fairness of the rewards for ones

own attempts, and on the fairness of the distribution of efforts among groups and individuals in society. The scientific job, thus, is to understand, to describe, and to communicate, more than to measure and to construct.

### **3. Who are “the users”?**

In WALCYNG we have always differentiated between users and potential users: Users, according to our definition are those people who already walk and cycle instead of using the car for short trips. Who are they? We have learned that women, elderly people and children/youngsters are more often users in this sense, than other citizens are. They represent societal groups that so far do not have much power, which is combined with the fact that they are not getting heard as much as others are. Thus, their needs and wishes have to be made transparent and to be considered when measures are taken, so we do not lose them as users as soon as they get a chance to change mode. Potential users are those we want to gain – for trips that are shorter than 5 km they should leave the car and join the walkers. A good precondition to achieve this would be the creation and keeping up of good conditions for current users as was just mentioned above, and to combine these efforts with efficient communication measures. However, what “good preconditions” and “efficient communication” depends on the user’s perspective. Knowing “who the users are” means also to know their taste and their opinions with respect to walcyng facilities and all efforts to market them.

### **4. Differences between countries – back to context aspects**

It has repeatedly been said that values, taste, life style, etc. – in summa, culture – constitute a most relevant background to the development and carrying out of behaviour. They are the highest-level context variables. Identical stimuli presented in different countries – or even in different cities in the same country – may have different effects. This is a problem as long as there are no systematic experiences with such differences, and no “transformation rules” saying that certain conditions that generate results of type A in one country may lead to results of type A’ in another country. The better comparable information policy will be done in several countries simultaneously the better known such predictions will be, though. This is an extra argument for carrying out information policy regularly.

### **5. Segmentation of user groups**

What has been said under point 3 and 4 reflects the aspect of segmentation: To consider the characteristics of different user-group segments will be necessary in order to efficiently enhance walcyng. Theoretically, every user group segment could have different points of view on good product and communication quality. Analysing this question will show what differences there are between the segments, and it will probably also show that there is not an endless list of differences between the user-group segments, but that there are only some, though important, differences that have to be considered, as is known from ordinary marketing. In many cases, the same marketing strategy applies for all groups and segments, or for a large part of them. It is important to find out, however, when this is not the case in order not to lose relevant groups or segments (like, e.g., young road users, who have to be addressed in a special way, differently from ordinary communication with grown ups). Some user-group segments have a key function, e.g., when the minimum standards of product comfort are concerned, as is the case with disabled users. Special attention has to be given to these aspects.

## **6. Evaluation**

Efforts to enhance walking instead of short car trips have to be evaluated. This is the only way to find out what solutions are really good, in practice. Combined to information policy, this would mean that one first tries to meet different target groups' needs, and that one then analyses whether such attempts were successful. Such evidence would give strong support to adequate implementation and management activities: To show that any measure is successful because it is accepted by the citizens, that is therefore used to the expected extent, and that it is therefore time efficient but most of all cost efficient. The latter is a most important approach in times of restricted budgets. However, this implies that the chance to try and to test solutions is provided, which much more often than today could be done in the frame of pilot- and demonstration projects.



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*General problems of pedestrians and cyclists.* Internal report of Work Package No. 3. Report I: No. 3. 1996

*Safety problems of pedestrians and cyclists.* Internal report of Work Package No. 4. Report I: No. 4. 1997

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*Identification of positive product aspects and recommendation of new products.* Internal report of Work Package No. 7. Report I: No. 7. 1997

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*Inoculation.* Official report of Work Package No. 10. Report O: No. 4. 1997

*Outlining future lobbying.* Official report of Work Package No. 11. Report O: No. 5. 1998





# **Cost benefit analysis**



# Acceptability of fiscal and financial measures & organisational requirements for demand management

## Information on the Project

**Project No:** PL97-2258

**Commissioned by:** European Commission

**Lead partner:** VATT (Government Institute for Economic Research), Helsinki

**Partners:** VATT, ITS, UPM, TØI, TUD, TRIAS, MIP, UYORK, LTCON, C.I.S.R., FUA

**Project manager at TØI:** Lasse Fridstrøm

## Summary

### Objectives

European urban areas are marred by the problems of congestion and environmental degradation due to the prevailing levels of car use. Strong arguments have thus been put forward in support of a policy based on *marginal cost pricing* (European Commission 1996). Such policy measures – which would force private consumers to pay for a public service that was previously provided «for free» – are, however, notoriously unpopular with the general public and hence also with their elected representatives – the politicians.

There is thus an obvious paradox between economic theory, which suggests that marginal cost pricing is the welfare maximising solution to urban transport problems, and practical experience, which suggests that such pricing measures are unwanted by the affected population and hence hard to implement through democratic processes.

The *AFFORD* Project (Acceptability of Fiscal and Financial Measures and Organisational Requirements for Demand Management) for the European Commission has aimed to investigate this paradox and its possible solutions, through a combination of economic

analysis, predictive modelling, attitudinal surveys, and an assessment of fiscal and financial measures within a number of case study cities in Europe.

Within the AFFORD project, strategic or tactical modelling case studies have been made for three different cities: Edinburgh, Helsinki and Oslo.

The general methodological framework of the AFFORD modelling exercises is an adaptation of standard cost-benefit analysis. Cost-benefit accounts are drawn up relative to a base case («business-as-usual», «do-minimum», reference) scenario, and subdivided between various institutional sectors.

To find the optimal («*best practice*») combination of second-best policy instruments, the transport models are used to calculate the elements of the cost-benefit accounts, and an optimisation procedure is used to tune the policy instruments available to the levels that maximise the overall economic efficiency function. Policy instruments considered include cordon toll charges, parking charges, fuel tax, vehicle tax, and public transport level-of-service and fares.

Best practice second-best solutions are compared with the theoretical first-best «benchmark», which – although impossible to implement in practice with today's technology and legislation – is perfectly computable in a network assignment model (see section 3.2). In the first-best solution, road users are made to pay a charge exactly equal to the marginal external cost in equilibrium. This charge varies continuously in space and time, so as to reflect, *inter alia*, instantaneous fluctuations in congestion costs.

The general optimisation principle applied in the AFFORD project is that of maximising the function

$$EEFP = B - I + EC + \lambda \cdot PVF,$$

where  $B$  is the net present value of added benefit to transport users (consumer surplus), compared to the base case scenario,  $I$  is the present value of the cost of infrastructure investments,  $EC$  denotes the environmental benefit (accidents, noise and pollution),  $PVF$  is the present value of finance, i.e. the net financial benefit of the policy to government and other providers of transport facilities, and  $\lambda$  denotes the «shadow price of public funds», i.e. the cost – in terms of economic efficiency – of raising one unit of public revenue through tax schemes other than road pricing.

## **Final results and conclusions**

Depending on the local conditions, on the shadow price of public funds, and on the array of policy instruments used, annual welfare gains from marginal cost pricing are found to vary between € 12 and € 400 per capita, as measured by the willingness-to-pay within the affected urban population.

As might be expected, the welfare gains from marginal cost pricing are relatively small in cases where (i) congestion levels are modest, (ii) the policy instruments available are few and coarse, and (iii) the opportunity cost of public funds is small or negligible. Whenever

one or two of these conditions are *not* met, however, the welfare gains from marginal cost pricing are likely to be considerable.

Road pricing schemes have the double consequence (i) of discouraging road use at least at certain times on certain parts of the network, and (ii) of transferring cash from private persons to public funds.

The fact that road pricing – at least in the first place – involves a transfer of cash from private travellers to public institutions, is likely to be a major impediment to its public acceptability. The implementation of efficient road pricing policies typically affects equity in a way that policy makers and/or the general population are likely to disapprove of.

Therefore, to render marginal cost pricing schemes politically and publicly acceptable, it is probably necessary to recycle the revenue generated in such a way as to keep most population subgroups at least equally well off. Such redistribution schemes appear by no means infeasible, but in the process of redistribution large parts of the initial efficiency gain may in important cases (i.e., if there is a non-zero shadow price of public funds) be lost. Thus, marginal cost pricing accentuates the traditional conflict between the goals of economic efficiency and equity.

#### **Main reports, papers and articles**

##### **Directed towards planners, policy makers, and the general public:**

Fridstrøm L, Moilanen P, Shepherd S, Minken H & Vold A

*Economic and equity effects of marginal cost pricing in transport: Case studies from three European cities.* AFFORD Deliverable 2A. VATT Research Reports No 71. Helsinki, 2000.

Fridstrøm, L

Vinnare och förlorare i olika typer av vägavgiftssystem: modellberäkningar för Oslo. ("Winners and losers under various marginal cost pricing schemes: modelling results for Oslo" – in Swedish). Working paper SM/1216/00, Institute of Transport Economics, Oslo. Paper commissioned by the County of Stockholm and presented at a seminar on the equity effects of road pricing, Stockholm, Nov 1, 2000.

Fridstrøm L, Minken H & Vold A

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Fridstrøm, L

Fordelingsvirkningene av vegprising. ("The distributional effects of road pricing" – in Norwegian.) Presentation made to the Board of Directors of the Norwegian Road Federation and to the Transport Committee of the Norwegian Parliament, February 10, 2000.

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Operationalisation of Marginal Cost Pricing within Urban Transport. Project AFFORD, funded by the European Commission, 4th Framework Transport RTD. VATT Research Reports No 63. Helsinki, 2000.

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Schade J, Schlag B, Giannouli I & Beier A

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### **Directed towards the research community:**

Fridstrøm L, Minken H & Vold A

*The income distribution effect of road pricing: a modelling case study*. Paper submitted to the European Transport Conference, Cambridge, 10-13 September, 2001.

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*First-best and second-best marginal cost pricing: modelling case studies from three European cities*. Paper submitted to the 9th World Conference on Transport Research (WCTR), Seoul, July 22-27, 2001.

Fridstrøm, L

*Tarificación vial en las urbes europeas: modelización de su eficiencia económica y de sus efectos con respecto a la distribución de ingresos*. ("Road pricing in European cities: modelling its effects on economic efficiency and on the income distribution" – in Spanish.) Presentation made at the Department of Transport Engineering, Pontificia Universidad Católica de Chile, Santiago, December 12, 2000

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*Efficiency and equity of marginal cost pricing in road networks.* Paper submitted to the 9th World Conference on Transport Research (WCTR), Seoul, July 22-27, 2001.

Vold, A

Regional transportmodell for Oslo og Akershus (RETRO) – modellstruktur og anvendelser. ("The RETRO regional transport model for the Oslo and Akershus counties: structure and applications" – in Norwegian.) Presented at the PROSAM conference "What needs do we have for reliable traffic data and models?", Hurdalsjøen Hotel, November 12, 1999.

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*Road pricing strategies for the greater Oslo area.* Oslo, Institute of Transport Economics, report 465/1999.

## FATIMA

# Financial Assistance for Transport Integration in Metropolitan Areas

### Information on the Project

**Project No:** UR-97-SC.1015

**Commissioned by:** European Commission DGVII

**Lead partner:** ITS, University of Leeds

**Partners:** TUW, VTT, CSST, TØI, ATM

**Project manager at TØI:** Harald Minken

## Summary

FATIMA had the following objectives:

- (i) to identify the benefits to the private sector of optimal urban transport strategies, and the potential for obtaining private sector funding to reflect those benefits;
- (i) to determine the differences between strategies optimised using public funds and those optimised within the constraints imposed by private funding initiatives;
- (ii) to propose mechanisms by which private sector funding can be provided so as to achieve appropriately optimal transport strategies while maintaining quality of operation; and
- (iii) to use the results to provide more general guidance on the role of private sector funding for urban transport in the EU.

The project adopted an approach which involved the application of the same study method to nine cities, chosen to reflect a range of urban transport policy contexts in Europe: Edinburgh, Eisenstadt, Helsinki, Merseyside, Oslo, Salerno, Torino, Tromsø and Vienna. This method involved specifying appropriate policy objective functions against which transport policy packages could be assessed, and finding the specific strategy that optimised each of these functions. Available transport models were used to assess the



impacts of the tested strategies and provide input to the objective function. The objective functions covered a range of differing regimes with respect to constraints on public finance and the involvement of the private sector, including full deregulation at the one extreme and full public responsibility and control at the other extreme.

The method of optimisation with respect to a package of policies built on previous work in the OPTIMA project and extended it to constrained optimisation, the constraints stemming from the available transport budget and the conditions of private sector involvement in public transport operation. The economic efficiency objective function likewise built on OPTIMA work, but included accidents and environmental costs. Innovative forms of financing, such as a "value capture" tax, were included in some of the policy packages.

## **Main results and conclusions**

It was found that, in a majority of the case study cities, optimal policies with respect to economic efficiency could be funded by road pricing or increased parking charges, considered over a 30 year time horizon. Such measures would typically be used to make it feasible to increase public transport frequency levels or decrease public transport fares. In general it was found to be important that the city transport planning authority had complete control over all transport measures, affecting both private and public transport.

However, such strategies are likely to require significant levels of investment and, given current attitudes towards constraints on public spending, it might be politically awkward for the public sector to raise such finance. There is thus a potentially useful role for private finance to be used to help overcome such (short term) financing problems. However, it must be appreciated that the private sector will expect to make a profit on such investment. In cities where optimal policies are funded by travellers, the private sector can be reimbursed by travellers. In cities where it is unfeasible for travellers to fund all the costs of optimal policies, it will be necessary for the private sector to be reimbursed from public funds (raised from taxes). An important issue here is that the use of private finance should not be allowed to replace optimal policies with sub-optimal policies.

Whether or not the private sector is involved in financing a strategy, there may be interest in private sector operation of the public transport service. However, evidence on the scale of benefits or losses from such operation is unclear. If, though, a city authority decides that private operation is beneficial, it should use, where legally possible, a franchising model in which it specifies optimal public transport service levels and fares. On the other hand, if a deregulation model is required (in order to comply with national law), private operators should not be given complete freedom to determine the operating conditions which meet their profitability target, even if the level of profitability is itself constrained as a result. There are typically a number of combinations (e.g. of fares and frequency) which achieve a given level of profitability, and not all will be equally effective in terms of public policy objectives.

## Final reports, papers and articles

### Reports

The final report has been approved and is forthcoming. The summary report and other project reports can be found at the website <http://www.its.leeds.ac.uk/projects/fatima>. The Work Package 20 Report is also available from TOI as TOI Working Paper TØ/1094/1998.

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- May, A.D., S.P. Shepherd, P.M. Timms (1999) The specification of optimal urban transport strategies. Pages 507-520 in Meersman, Van de Voorde and Winkelmanns (eds.) *World Transport Research. Selected Proceedings of the 8th World Conference on Transport Research, Volume 2*. Pergamon, Amsterdam.
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### Submitted to journals

- May, A.D., S.P. Shepherd and P.M. Timms. The specification of sustainable urban transport strategies. Paper submitted to *International Journal of Sustainable Development and World Ecology*.
- May, A.D., S.P. Shepherd, H. Minken, T. Markussen, G. Emberger and P. Pfaffenbichler. *The use of response surfaces in specifying transport strategies*. Paper submitted to *Transport Policy*.
- Timms, P.M., A.D. May and S.P. Shepherd. *The sensitivity of optimal transport strategies to specification of objectives*.

# OPTIMA

## Optimisation of policies for transport integration in metropolitan areas

### Information on the Project

**Project No:** UR-95-SC.109

**Commissioned by:** European Commission DGVII

**Lead partner:** ITS, University of Leeds

**Partners:** TUW, VTT, CSST, TØI

**Project manager at TØI:** Harald Minken

## Summary

### Objectives

The overall objectives of Project OPTIMA were:

- to identify optimal urban transport and land use strategies for a range of urban areas within the EU;
- to compare the strategies which are specified as optimal in different cities, and to assess the reasons for these differences;
- to assess the acceptability and feasibility of implementation of these strategies both in nine case study cities (Edinburgh, Merseyside, Vienna, Eisenstadt, Tromsø, Oslo, Helsinki, Torino and Salerno) and more widely in the EU; and
- to use the results to provide more general guidance on urban transport policy within the EU.

### Tasks

These objectives were achieved by carrying out the following tasks:

- specify two objective functions, one each for economic efficiency and sustainability, which are acceptable to, and can be applied in, all the cities being studied;
- identify, separately for each city, an acceptable set of transport and land use policy instruments, and to extend this list to cover measures in use elsewhere in the EU;

- conduct a series of tests of combinations of policy measures, in each city, using currently available transport models of these cities;
- use the optimisation methodology, separately for each city, to identify strategies which are optimal in terms of economic efficiency and sustainability in each city.
- draw policy conclusions for each city on the differences between the efficiency-optimal and sustainability-optimal strategies, the justification for those strategies, and the feasibility of implementation, in discussion with the city authorities;
- draw project-wide conclusions by comparing the results for the different cities, explaining the differences between them, and discussing their applicability in other EU member states.

## Main results and conclusions

The results from the optimisation process are summarised in Table 1, which gives an overview of the relative benefit (over the nine case study cities) of each measure with respect to the two objective functions used. EEF is the Economic Efficiency Objective Function, and SOF is the Sustainability Objective Function.

**Table 1:** Summary of beneficial measures

	EEF	SOF
Public transport infrastructure	-	**
Low cost road capacity improvements	***	**
Increase in public transport frequency	*	**
Reduction in public transport fares	**	***
Road pricing and/or increased parking charges	**	***

\* indicates there is (overall) a small benefit to using the measure

\*\* indicates there is (overall) a medium benefit to using the measure

\*\*\* indicates there is (overall) a strong benefit to using the measure

From the results in Table 1 and from other aspects of the research, the following recommendations can be made for policy makers:

- strategies should be based on combinations of measures, and should draw fully on the synergy between success measures;
- economically efficient measures can be expected to include low cost improvements to road capacity, improvements in public transport (increased service levels or reductions in fares), and increases in the cost of car use;
- public transport infrastructure investment is not likely, in the majority of cases, to be a key element in economically efficient strategies; reductions in capacity to discourage car use are not likely to be economically efficient;
- the scale of changes in service levels and fares will be influenced by the current level of subsidy; in some cases a reduction in service levels or an increase in fares may be justified on economic grounds;

- the scale of increase in costs of car use will depend in part on current levels of congestion; the study suggests that road pricing and parking charge increases are broadly interchangeable, but this needs assessing in more detail;
- in most cases economically efficient strategies can be designed which are financially feasible, provided that revenues can be used to finance other strategy elements;
- the pursuit of sustainability is likely to justify investment in public transport infrastructure, further improvements to public transport services and/or fares, and further increases in the cost of car use;
- availability of finance will be a major barrier to implementation of many sustainability-optimal strategies, and further work is needed to investigate the extent to which financial costs can be reduced by strategies which are slightly sub-optimal;
- legislation will be needed to enable implementation of road pricing and to control parking charges; in the UK and Italy there is also a case for changing legislation to permit economically more efficient public transport strategies;
- public acceptability will be a significant barrier with those measures which reduce service levels or increase costs; this implies the need for effective public relations campaigns, and carefully designed implementation programmes;
- detailed measures to improve the environment and provide better facilities for cyclists, pedestrians and disabled people should be designed within the context of a preferred strategy.

#### Methodological conclusions and recommendations

- the optimisation procedure has been shown to be successful, and has attracted widespread interest; however, it is important that careful thought is given to the policy implications of each stage of the process;
- the frequent use of upper and lower bound values in the optima is a cause of some concern;
- strategic models are in many ways more appropriate than tactical models in the development of optimal strategies;
- such models should include walking and cycling, both peak and off peak conditions, and the effects of public transport loadings on user costs.

#### References and further reading

##### **Reports**

The final report is:

European Commission (1998) *Transport Research Fourth Framework Programme, Urban Transport 55: Optimisation of policies for transport integration in metropolitan areas – OPTIMA*. Office for Official Publications of the European Communities, Luxembourg.

The summary report can be found at <http://www.its.leeds.ac.uk/projects/optima>. This site also contains the Deliverables (Work Package Reports), available as ITS Working Papers. The Work Package Reports are:

OPTIMA (1997) *Work Package 10: Objective Functions*. ITS Working Paper 498 (also available from TOI as TØI Working Paper TØ/898/96).

OPTIMA (1997) *Work Package 20: Identify Policy Instruments*. ITS Working Paper 499.

OPTIMA (1997) *Work Package 30 and 40*. ITS Working Paper 500.

OPTIMA (1997) *Work Package 50: City Study*.

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# **Freight transport**





## SCANDINET

# Promoting integrated transport in peripheral areas of the Union. Case Scandinavia

### Information on the Project

**Project No:** IN-96-SC.1174

**Commissioned by:** European Commission DGVII

**Lead partner:** Technical Research Centre of Finland (FI)

**Partners:** VTT (FI), NTU (DK), CBS (DK), CTH (S), ET&P (ES)

**Associated partners:** AF (N), URo (DE), TØI (N), MTC (FI), M-S (FI), SILJA (FI)

**Project manager at TØI:** Johanna Ludvigsen

## Summary

### Objectives

The SCANDINET project was designed to meet the requirements of Integrated Transport Chains. Its overall goal was "To improve access to the infrastructure, information and market for intermodal freight transport services - in particular for SMEs and isolated flows". The overall objectives of SCANDINET were:

- To identify the potential demand and supply for intermodal transport services, including line haulage, pick up and delivery for peripheral and isolated areas of the EU.
- To identify the possibilities to combine national, international and transit flows into selected corridors and terminals by using intermodal transport.
- To study the possibilities to extend the viable usage range of intermodal transport to distances below 700 - 800 km.
- To identify the gaps and bottlenecks in information flows. To define a concept for operational organisation for real time information services. The feasibility of establishing new businesses to process information was to be assessed.
- To validate developed concepts with simulation and field trials.
- To draw policy conclusions for peripheral and isolated areas and to design a guide for intermodal transport users and service providers.

## **Methods**

The SCANDINET project sought possibilities to broaden utilisation of intermodal transport, especially in peripheral regions of the EU. This goal was approached by using Scandinavia as a case area, and there by studying existing databases, interviewing users and service providers of intermodal transport, surveying the present corridors, terminals and technologies and by studying possibilities to utilise up-to-date information technology. After getting sufficient knowledge about the market conditions and requirements, a number of concepts for intermodal transport were created. New concepts were based on existing technology.

The PACT study is concentrated on a small geographical area round North Jylland in Denmark with international links to Norway and Sweden. In the SCANDINET project the market indications found in the PACT project have been used as basis for further research of new concepts and using broader geographical (but still peripheral) areas.

Innovations and concepts in the SCANDINET project are based partly on the findings in the PACT program, partly on ideas and wishes suggested by the operators and users involved in the project. In the preparatory phase of the SCANDINET proposal, several ideas concerning corridors and innovations were discussed. As there have been operators and users involved in these discussions, the ideas had a strong market background.

## **Main results and conclusions**

In the Scandinet project we have estimated both actual and potential commodity flows, as well as intermodal transport flows (unit loads) between the Nordic countries and the European Continent. Goods flows are concentrated in quite a few transport corridors which are well defined in Scandinavia. Scandinavia is strongly dependent on sea-land bridging solutions.

The flow study showed that substantial volumes in Scandinavian foreign trade use congested corridors in northern Continental Europe. Reasonable continental intermodal track rates, a fair continental railway slot practice and accessible continental freight freeways are important to the success of intermodal freight transport between the Nordic countries and the Continent.

Trade statistics give an unsatisfactory picture of modes involved in transport, and statistics on movements of Intermodal Transport Units (ITU) are even poorer. This makes it imperative that the Commission speeds up initiatives on improving the statistics on international flows of ITUs. Such statistics should include commodity specification (which is now rarely available), records of distance transported by different modes, and as a principle be based on mapping transport chains. Since complete statistics of this kind would be very costly and difficult to obtain, and might violate principles of confidentiality, the statistical procedures and techniques of sampling to be used would have to be designed with utmost care.

We have identified and quantified important service characteristics for both single modal and intermodal (rail and sea based) freight transport. The results show that a gap exists

between the quality of service desired and the quality of service supplied. It seems that shippers do not differentiate between the quality requirements for single-modal and intermodal transport. Cost is not the only factor but occurs in conjunction with other quality dimensions. Before shippers order a major transport and logistics service they typically establish a service quality vector specifying minimum requirements in a number of dimensions. Invitations to tender are then submitted and those who can trustfully prove that they are able to meet the service vector specification are invited to price negotiations. Ultimately the bidder who combines assurance in meeting service vector requirements with the lowest price will win. The analytical tools employed by researchers do not always have the capability to reflect such a procedure. This explains why research results must be handled with care.

The Scandinet project studied several actors involved in intermodal service. One such operator had long experience on transport between the UK/Ireland and Denmark. The need was to improve the quality in the national Danish rail system between Esbjerg and Copenhagen. The operator had the role of an integrator, organising the handling, booking etc. and subcontracting the block train service. Operators in the trucking business were replaced by a block train operator. Profit is also the main objective of the transport business, and the block train service has so far proved profitable. One of the key elements in the set up of this service was the new fixed link across the Great Belt replacing car and rail ferries. In this case the decision makers have a real instrument: the pricing of the new link. So far no priority has been given to intermodal transport.

Short distance, and often national and long distance intermodal services are not sufficiently integrated. Findings seem to confirm that intermodal transport in peripheral areas needs to be hierarchically connected to a network of high volume terminals supplemented by small scale services based on low volume terminals. Low cost flexible terminals can be developed for low flows. The system should make maximum use of equipment that can handle unloading and loading operations at terminals with minimum use of stationary personnel and equipment. This seems to be one of the serious ways to reduce capital costs at terminals per unit handled while maintaining a high productivity of the equipment and vehicles involved.

Closer links are needed between hinterland intermodal and ferry & Ro-Ro connections in the Scandinavian countries and between Scandinavia and the Continent. Commodities carried by ferries and Ro-Ro vessels are highly suitable for intermodal transport. Lorries and semi-trailers carried over sea, especially on longer sea routes, constitute a direct target for marketing efforts of intermodal operators. Bundling of cargo flows in ports/terminals creates a necessary minimum of units needed for efficient intermodal transport. Closer co-operation between ferry and Ro-Ro operators and intermodal operators is needed in order to overcome operational obstacles. Development of ports/terminals must be taken into account in the integration of efficient intermodal terminals, especially in capitals.

There are no simple solutions and no simple instruments that will make intermodal transport viable. In the SCANDINET project we have found cases and practices which have demonstrated that intermodal transport can be viable even with small flows, e.g. the Arctic Rail Express (ARE) case in Norway. We have also found cases which promise successful intermodal transport even under conditions initially adverse to it, e.g. the Esbjerg-Copenhagen connection in Denmark and the Swedish LightCombi concept. We

have identified factors which can make intermodal transport viable even over distances shorter than 700-800 km such as route specific issues, adequate initial (balanced) flows, increased handling and terminal efficiency. Sufficient volume, and one or several major customers are necessary to start up the service. The start up is not always dependent on distance. Also organisational issues are significant for the success of intermodal transport. It is important that a transport organiser takes on the responsibility and liability of providing the service. In SCANDINET terminology, the transport organiser is called the problem owner. In many cases today, the kind of problem owner needed is missing.

Several legal supporting actions exist in different EU countries but no specific common policy can be found in Scandinavia. Some national actions and proposals exist, such as the Swedish White Paper which proposes direct subsidy for intermodal operations in Sweden. General environmental impacts are well known and documented, but specific intermodal or Scandinavian studies and knowledge are lacking.

The current long stops in intermodal rail-based transport must be eliminated or at least dramatically reduced. The difference in technical level of operators mostly corresponds to the size of the enterprise. Efforts to increase the overall efficiency of the intermodal transport chain depend largely on eliminating this bottleneck. To obtain this, the information flow has to be smoother, more reliable and complete between the different parties. Because of the enormous difference in the technical level of operators and end-users, the information flow must be based on simpler and cheaper methods than those employed in recent years. Small and medium sized enterprises (SMEs) are hesitating in implementing standardised communication methods like EDI and need simpler, less expensive solutions.

A wide range of different information technologies exists. There is a demand for products in intermodal business, but suitable products especially for SMEs are lacking. There is also a serious shortage of standards. Pan-European identification and tracking systems and standards should be developed. The operator who communicates with the user must have the relevant information. The planning systems connected to tracking systems are the key elements in intermodal operations. A SCANDINET demonstration with an SME intermodal operator showed that correct and relevant information is of importance in different phases of the transport chain, especially the mode change. Such information in intermodal operations is possible when transport documents and information dealing with the shipment are delivered between parties by means of electronic data transfer (EDI and Internet). Today, the resources of SMEs are not sufficient for the development of these systems and their competitiveness is weakening.

The solutions can be established on new information concepts that rely mostly on tools like Internet and centralised databases using the Internet protocols as the main communication methods. Such a centralised database should be fed with up-to-date information on all participating operators, ensuring up-to-date information on consignment location and status.

The Scandinet results show that it is possible to create intermodal services in peripheral areas and over short distances on a commercial basis. Supporting, market oriented actions or instruments are needed to push the development forwards. The steps taken so far are not sufficient.

## **News, reports, papers and articles**

### **Reports**

The final report has been approved and is forthcoming. The summary report can be found at <http://www.cordis.lu/transport/src/integrat.htm>.

### **Articles**

Grøhn, J (1998):

Intermodal transport research - is there any value added. *Nordic Road and Transport research. Vol. 10 Nr 2/1998*. VTI Information, Linköping, Sweden.



# **Strategic research**





# STEMM

## Strategic European Multimodal Modelling

### Information on the Project

**Project No:** ST-96-SC.301

**Commissioned by:** European Commission, Transport RTD Programme of the 4<sup>th</sup> Framework Programme

**Lead partner:** Baxter Eadie Limited, United Kingdom

**Partners:**

BETA, Université Louis Pasteur, France

CERTE, University of Kent, United Kingdom

Coherence, Belgium

DST.DOT, Department of Environment, Transport, and the Regions, United Kingdom

ECOPLAN, Switzerland

ITS, University of Leeds, United Kingdom

IWW, Universität Karlsruhe, Germany

MDS Transmodal, United Kingdom

MKmetric, Germany

SINTEF, Norway

Technicatome, France

VTT, Finland

**Associate partners:** INRO, Canada, NEC, Ireland, Temaplan, Sverige, TØI, Norway

**Project manager at TØI:** Siv Ingebrigtsen/Inger-Anne Sætermo

## Summary

### Objectives

The objectives of the STEMM project were:

- Identify and quantify the factors affecting modal split and route choice for passenger and freight, particularly where intermodal chains are available.
- Develop methodology for modelling intermodal chains for passenger og freight transport.
- Apply the developed methodologies to models representing mode and route choice for European networks and particular case studies.

- Examine barriers to intermodality arising from institutional and regulatory measures.
- Utilise these models to examine and test policy measures for increasing the use of intermodal methods of transport.
- To present contributions at seminars on results obtained from investigations of different types of policy instruments.

As such the project addressed Tasks 1.3/20 and 1.3/21 of the Strategic Transport Research Programme.

The principal thrust of the project has been the development of strategic models for passenger and freight transport which are spatially aggregated at the intercity or inter-provincial major corridor level.

A sub-project has focused research on modelling qualitative aspects reflecting the behaviour of all actors involved in intermodal transport (operators, producers, carriers, policy makers, etc.) in order to provide tools that can capture and assess in a systematic way the response of all changes in the intermodal environment.

## **Methodes**

There have been three principal aspects within STEMM:

- Passenger Transport
- Freight Transport
- Assessment of Political and Social Acceptance of Transport Measures

Within each, work was undertaken on model development, implementation and data collection, and the application of the techniques to case studies. These tasks were organised in 14 work packages, with groups of partners working on each work package.

## **Main results and conclusions**

### **Passenger Transport**

A sophisticated multi-country model of passenger transport (MAP-1) has been developed, with innovative representation of non-linear modal choice, integrated multimodal networks, and estimation techniques taking account of variation and correlation in estimation precision. This model covers three trip purposes: business, private and vacation. It has been applied to the Scan-Link Corridor and to the Trans-Alpine region.

#### *Scan-Link Corridor:*

New connections from Scandinavia to the continent via Denmark increase car trips in the corridor, but train trips may increase much more and their future share may be higher than the share of car trips. The impacts vary between countries, as the basic properties of transport systems differ greatly.

*Trans-Alpine:*

1. The improvement of airport access does not necessarily lead to the expected result of an increased use of intermodal chains with an air component.
2. Charging road and air with emissions-dependent costs provokes reactions which are in terms of changes in modal split stronger than in the Advanced Transport Infrastructure scenario.
3. Regardless of whether there are strong reactions to the measures taken in the Internalisation of External Costs scenario, internalisation of external effects of traffic may prevail on industry to speed up development of vehicles and aeroplanes which are low on emissions.

The output of the STEMM Passenger Model clearly indicates that the best way towards sustainable transport is to support improved infrastructure supply by economic incentives.

**Freight**

Two freight transport models have been developed and tested, both using similar conceptions of factors affecting mode and route choice. The MDST model has been applied to assess policy effects on Trans-Alpine and cross-Channel freight transport, while the STAN model has been implemented for Nordic case studies of Scan-Link Corridor and Nordic/North Sea freight movements. The model results from both models seem sensible.

Conclusions for policy instruments for freight movements as derived from the case studies:

*a) Mainland Europe*

- Technical barriers (e.g. standardisation) are rated lower than barriers concerning the general set-up for intermodal transport.
- There are distinct differences between the results of the surveys since they look at different regions and different types of intermodal services. For Trans-Alpine transport the most relevant barriers are seen in organisational and institutional issues and in the current price signals and structures in intermodal transport as well as in the transport sector as a whole. The missing internalisation of external costs in road transport was mentioned explicitly by a number of respondents. In the Nordic countries “hardware” barriers have been rated almost as high as barriers referring to organisational/institutional and pricing issues.
- The need for customer-oriented information and communication systems has been confirmed, and the potential distortion of competition through subsidisation has been critically mentioned.

*b) UK*

- The use of rail mode for multi-modal chains is more difficult than ship and barge.
- The most important difficulty is seen to be the financial barriers (i.e. high investment costs of the provision of intermodal services). Furthermore, the quality of service and organisational barriers have been rated comparatively high.
- Rather low figures have been allocated to technical interoperability problems and insufficient information systems.

### **Assessment of Political and Social Acceptance of Transport Measures**

Tools and methods (EMERIT) for efficient description and assessment of qualitative characteristics of the total environment within which development projects are undertaken have been developed. Arising from the Pyrenees Crossing Case study, it can be concluded that the benefits of the EMERIT are:

- An administrator can detect the potential weaknesses of the project (stagnation of indicators) and check if this stagnation is due to a fast convergence towards an obvious solution or to a lack of exploration of all possible solutions, maximising in this way the chances of success of the project.
- An administrator could very clearly locate the drift and type of difficulty from which a project may suffer. From that position, the administrator would be able to anticipate and initiate test to optimise the learning curve of the project.

The following points arising from the Walloon Region Case Study could be of interest for a regional policy assessment:

- A first alert comes from the changes of configurations of the actor network. The danger comes when a public authority does not feel concerned any more.
- The inspection of the learning curve regarding the alternatives is important.
- The indication of criticalities and their modes of retroaction in the project is fundamental. If such a criticality is not perceived or is not taken into account, the duty of the administrator is to oblige the AAPP to take note and react consequently. This must be done in a positive way, by building with the actor the adequate answer.

### **Main reports, papers and articles**

#### **STEMM Strategic European multi-modal modelling**

"Methodological Development within the Quasi-Direct Format Demand Structure: The Multi-Country Application for Passenger MAP-1" by Gaudry M, Heinitz F, Last J and Mandel B. BETA Working paper 9815, Université Louis Pasteur, Strasbourg. Presented at a one-day presentation at the SES, french Ministry of Transport (MEI.TT), Paris in Oct. 1998.

"Tests of Non Linearity, Modal Captivity and Spatial Competition within the STEMM Passenger Demonstration Model-MAP1" by Gaudry M. Presented at the Seminar on National Transport Models in Stockholm in Dec. 1998. Published in a book edited by Lundquist L and Mattson G in 1999.

"Short-Run and Long-Run Logistic Impacts of a Major Transport Infrastructure" by Normann C, Sharp D and Vickerman R. Presented at the 8<sup>th</sup> World Conference on Transport Research, July 1998, Antwerp, appearing in the published proceedings by Elsevier, 1999.

"Origin and Destination Survey of UK International Trade 1996" Published 1998 by Department of the Environment, Transport and Regions.

"Freight Mode/Route Choice Modelling with Limited data" by Fowkes, AS and Tweddle G. PTRC, London 1998. Proceedings of Seminar E. Transportation Planning Methods, vol II, code P424, pp 147-164.

## INIOSIAT

# Information Systems and Statistical Strategic Transport Planning in Europe

### Information on the Project

**Project No:** ST-96-AM.101

**Commissioned by:** EU Commission DG VII

**Lead partner:** NEA Transport research and training, Rijswijk, the Netherlands

**Partners:**

AGDER Research foundation, Kristiansand, Norway

IVT Institute für angewandte Verkehrs- und Tourismusforschung, Heilbronn, Germany

**Subcontractors:**

**AU** Aalborg University, Department of development and planning, Aalborg, Denmark

**CIEE** Club International d'Expansion Economique, Paris, France

**Infratest** Infratest Sozialforschung, München, Germany

**INRETS** Institut national pour la recherche dans les transports et la sécurité, Arcueil, France

**ITA** Institut du transport aerien, Paris, France

**IW** Ingenieurgruppe IW-Aachen, Aachen, Germany

**NTUA** National technical university of Athens, Athens, Greece

**Sofres** Sofres Conseil, Montrouge, France

**TOI** Institute of transport economics, Oslo, Norway

**UG** University of Gdansk, Gdansk, Poland

**UR** Rostock university, Institute of transport and logistics, Rostock, Germany

**VTT** VTT Technical research centre of Finland, Helsinki, Finland

**Project manager at TOI:** Knut Sandberg Eriksen

## Summary

The main objective of the project is to develop a methodology for establishing transport data bases and information system required for strategic transport planning at a European level, and which will serve DG VII as a basis for strategic decisions. This information system should be based on homogenous data on transport and infrastructure, with the

determinants of mobility as objectives and the need to create trans-European transport networks.

To summarise, the study should form the basic framework of the future European databases. The objective is not to arrive at an information system, which actually contains all possible and desirable transport relevant data, but to set those essential concepts and standards needed for the establishment of a European transport policy.

The study has been partitioned into three tasks:

**Task 1:** Develop a common system of definitions, basic concepts and standards, taking into account the need for new definitions on multimodality, new technologies, TEN extensions etc.

**Task 2:** Optimise the use of current data. Current data and methods of data collection have to be evaluated in view of their application as elements of the future European transport information system. Gaps in existing data and the need for future data collection should be identified and classified. Use of existing sources might be optimised by ensuring compatibility of data and data gathering.

**Task 3:** Develop schemes for immediate actions of data collection: There is no need to wait until the future information system is implemented to collect urgently needed data; as data users we are aware of gaps and discrepancies which limit the development of a European approach of transport, especially in relation to new member states and eastern Europe.

The use of workshops has been given an important role in the study. The study results are for a large part based upon the work that has been undertaken in the workshops.

## **Main results and conclusions**

The conceptual approach of ETIS (the European Statistical Information System) is based on the recognition that interrelations exist between the determinants of transport and the actual transport and traffic flows, and that appropriate observations, transport data and modelling tools are needed to analyse the transport performance and the external impacts of transport. The statistical framework of ETIS focuses on the information which makes explicit the following sequence principle:

Decision-makers at the Commission and their staff will be the main users of ETIS. However, a variety of other user groups will also be able to benefit from the system, like national administrations, regional and local authorities; researchers and consultants acting on behalf of policy decision makers; international organisations which are active in the field of transport; statistical bureau's and related institutions at the European and national level; transport and industrial enterprises, e.g. carriers and shippers, airports and harbours, tourist industry etc.

In its approach of conceptual definitions for the future ETIS, the INFOSTAT study has focused on the creation of new statistical concepts which are needed to understand changes in transport systems on a European scale; this is a prerequisite for a successful achievement of the objectives of the present and future Common Transport Policies (CTP). The objectives of sustainability (linking transport to environmental issues), TEN-T networks (linking transport to regional and technology issues), quality of transport (linking transport to the performance of the Internal Market), integration and intermodality (i.e. the integration of transport modes by transport chains), represent the corner stones of the present and future CTP and must therefore be the starting points for the corresponding list of statistical concepts. These four objectives are the reference for the development of the ETIS system as instrument of policy decision of the Commission.

It was clear that the old statistical concepts of the 1950s are not sufficient to support the achievement of European transport policy objectives. For this reason workshops have been organised bringing together decision-makers, statisticians, transport industry, and have been used as a source of fresh and innovative ideas. The outcome of their discussions has been a definition of new concepts and indicators, which constitute the statistical framework of the future ETIS system.

#### **Main reports, papers and articles**

Infostat deliverable i – the objectives of the study

Final report task 1: basic concepts and standards for a european transport information system

Final report task 2: documentation of general review process

Final report task 2: availability and suitability of existing for a european transport information system

Task 3: scheme for immediate actions of data collection

Task 3: wp e construction of the pilot data base

Final report infostat

Contractnr. St-96-am.101

Final report for publication

Infostat summary report

Infostat workshop books:

Workshop goods

Workshop passengers

Workshop infrastructure networks

Workshop economy and space

Workshop environment

Workshop architecture of information systems

Workshop new concepts



MIEST

## **Methods for European Surveys of Travel Behaviour**

*Information on the Project*

**Project No:** 2215

**Commissioned by:** European Union (DG VII), 4<sup>th</sup> Framework Programme

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**Project manager at TØI:** Jon Inge Lian

## Summary

### Objectives

The MEST Consortium was given two main tasks: (i) to provide the basis for a benchmark survey of long-distance travel behaviour and (ii) to improve the associated methods in the areas of sampling, imputation and weighting. Thus, while Task I deals with the work to be accomplished before the survey and during the field work, Task II discusses what to do when data have been collected in order to obtain consistent results.

Conducting Task I, the project developed and carried out a series of three waves of pilot surveys addressing the following questions:

- Wave I: Effect of temporal orientation (prospective/retrospective); Effect of data collection method (selfcompletion/telephone); Effect of respondent workload ("small" question set/"large" question set); Cultural effects (Sweden/Portugal)
- Wave II: Effects of trip versus stage reporting; Effects of page versus column presentation of survey; Effect of survey duration (4 and 8 weeks); Cultural effects (UK, Portugal, France, Sweden)
- Wave III: Draft benchmark survey: Test of specific minor alterations to the draft benchmark survey (UK and Sweden); Effect of temporal orientation (prospective or retrospective) (France); Cultural effects (UK, Portugal, France, Sweden)

### Methodological dimensions

#### Task I

Key points of the recommended protocol are:

- Person sample (direct or equivalent two-stage sampling from households) (oversampling of persons with more long-distance trips) (from age 6; proxy reporting until age 14)
- Initial postal contact combined with a series of three reminders consisting of postal reminders and telephone calls, which can be changed into full CATI interviews, as requested by the respondent; no incentives; general follow-up telephone interview with all respondents providing written applies

- Rigorous treatment of respondent errors within the follow-up interviews, during the possible CATI interview, fully documented imputations of missing items, fully documented weighting for unit-non-response
- Complete documentation of the data files in their various phases and of the contact history
- Face-to-face interviews with a subset of the sample for non-response correction, respectively quality check of earlier responses
- Continuous administration of the whole survey period (1 year minimum, 3-5 years recommended)

## **Task II**

Most of the methods concerning weighting and imputation procedures considered in this project are the result of recent researches, and some of them are still at the development stage, and not yet ready for widespread adoption in production survey work. Therefore, general practice in border and national travel surveys lead to the recommendation of the following simple methods:

For weighting in order to correct total non-response, especially in the general case when the sample has not been drawn from the census, a calibration on margins is a satisfactory method. The variables chosen for margins have to be correlated as much as possible with non-response behaviour. Generally the variables that explain the response mechanism are the following ones: size of conurbation, size of family, car ownership, age, ... (which also explain the mobility behaviour). It is better to calibrate separately for different zones, since the geographic factor is generally the most correlated with total non-response.

For imputation, all methods based on averages have to be avoided since they distort distributions by attributing the same value to all non-respondents. When a good relationship exists with variables with much less missing values (e.g. trip duration or impute trip length), it is possible to develop sophisticated imputation procedures that significantly improve upon simple procedures. Otherwise, hot-deck is very simple to implement and gives satisfactory results when the variables used to sort the data file are sufficiently correlated with the variable with missing data. When there are enough trips described by the same individual, it seems better to look for a similar trip made by the same individual (or by a member of the same household), than to run the hot-deck for the entire data file.



## **Deliverables**

Armoogum, J., M. Herry, J. Polak and J.L. Madre (1996) Sampling and weighting schemes for travel diaries: Review of issues and possibilities, report to the CEC, DG VII, *MEST Deliverable, D6*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.

- Armoogum, J., J.-L. Madre, X.L. Han and J.W. Polak (1998a) Improved methods for weighting and correcting of travel diaries, report to the CEC, DG VII, *MEST Deliverable, D8*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- Armoogum, J., J.-L. Madre, X.L. Han and J.W. Polak (1998b) Improved sampling schemes for travel diaries, report to the CEC, DG VII, *MEST Deliverable, D7*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- Armoogum, J., J.-L. Madre, X.L. Han and J.W. Polak (1999) Suggested administration and evaluation methods for travel diaries: a manual, report to the CEC, DG VII, *MEST Deliverable, D9*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- Axhausen, K.W. (1996) Possible contents and formats for long-distance travel diaries, report to the CEC, DG VII, *MEST Deliverable, D2*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- Axhausen, K.W. and M. Youssefzadeh (1999) Towards an European Survey of Long Distance Travel incorporating A new European long distance diary: Second draft of content and structure and A new European long distance diary: Final draft of content and structure, report to the CEC, DG VII, *MEST Deliverables, D3 and D4*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- MEST Consortium (1999) A suggested European long-distance travel diary, report to the CEC, DG VII, *MEST Deliverable, D5*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- Youssefzadeh, M. and K.W. Axhausen (1996) Long-distance diaries today: Initial review and critique, report to the CEC, DG VII, *MEST Deliverable, D1*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.

### **Working Papers**

- Armoogum J. and R. Ren (1999) Test de l'optimisation du plan de sondage pour les voyages à longue distance, *MEST Working Paper*, INRETS, Arcueil.
- Axhausen, K.W. and M. Youssefzadeh (1997) Tender documents: Second MEST pilots, report to the CEC, DG VII, *MEST Internal Working Paper, IWP03 and IWP04*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- MEST Consortium (1997) Proceedings, Second MEST workshop, September 1997, Lisbon, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- MEST Consortium (1998) Proceedings, Third MEST/TEST workshop, September 1998, Pörschach, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- Youssefzadeh, M. and K.W. Axhausen (1996) Tender documents: First MEST pilots, report to the CEC, DG VII, *MEST Internal Working Paper, IWP01 and IWP02*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- Youssefzadeh, M. and K.W. Axhausen (1998) Tender documents: Third MEST pilots, report to the CEC, DG VII, *MEST Internal Working Paper, IWP05 and IWP06*, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.

# PETS

## Pricing European Transport Systems

### Information on the Project

**Project No:** ST 96 SC 172

**Commissioned by:** Ms Catharina Sikow-Magny, EU, DG VII, 4<sup>th</sup> FP

**Lead partner:** University of Leeds, Institute for Transport Studies (ITS)

**Partners:**

Departamento de Economia Aplicada, EIET, Universidad de Las Palmas de Gran Canaria (Es)

Ekonomiska Institutionen, EKI, Universitetet i Linköping (Sw)

INRETS (Fr)

Ekono Energy Ltd (Fin)

TRT/CIRTRAS (It)

Institute of Transport Economics, TOI, (Nor)

Universitat Karlsruhe, IWW (De)

ECOPLAN (Switz)

TRANSPOR (Por)

Technische Universität Wien, IFIP (At)

**Project manager at TØI:** Randi Jule/Inger Anne Sætermo, Farideh Ramjerdi

## Summary

The main objectives of PETS were:

1. to examine the current pricing situation of passenger and freight modes in Member States;
2. to assess whether such prices provide appropriate price signals in the light of all relevant internal and external costs; and,
3. to forecast the consequences of moving to a more appropriate price level and structure in the light of transport demand and supply developments – as well as financial and other constraints.

## 2.1.3 Phases

The project was divided into three main phases:

- Phase I: Review – where a comprehensive review of theory, current practice and pricing trends, and empirical estimates of appropriate price components were constructed;
- Phase II: Conduct of Case Studies – during which 5 case studies covering a variety of contexts were carried out in order to determine the appropriateness of existing prices and the impact of moving to prices that better reflect external costs; and,
- Phase III: Synthesis and Conclusions – during which the Phase I and Phase II findings are drawn together and the pricing policy implications established.

The methodological approach used in the conduct of case studies was to fully identify the producer, user and external costs associated with passenger and freight transport and to compare the prices associated with those categories with existing taxation and charging levels and structures. This was carried out for the year 2010, for the case studies:

- Cross Channel passenger and freight study;
- Transalpine Freight study;
- Finnish passenger and freight study;
- Oslo-Gothenburg passenger study; and,
- Lisbon, Tagus Crossing passenger study.

Each of the case studies included all the key passenger and/or freight modes of relevance in the study area in a modelling framework.

## 2.1.4 Conclusions

The key conclusions reached are as follows:

1. A major conclusion is that the methodology to calculate marginal social cost for all modes exists, although many of the valuations remain subject to considerable uncertainty. No support is found for the argument which says that the concept of marginal cost pricing cannot be implemented in practice because it is unmeasurable. However, this does not mean that all the relevant agencies currently possess the information and ability to estimate marginal social cost, so further efforts to disseminate this may be needed. The case studies have illustrated that marginal social cost may be estimated for a range of circumstances in a range of countries.
2. It has been shown that a purely commercial approach to transport pricing is not appropriate and may push prices in the wrong direction. The reason is the prevalence in the transport sector of economies of scale, including the Mohring effect, whereby increases in demand for scheduled public transport services lead to increased service frequency and therefore better services for existing passengers, and because of the importance of externalities. Whilst the former lead to commercial prices being too high, and the latter too low, the relative strength of the two effects differs enormously between the modes and locations.

3. In measuring externalities for pricing purposes, it is important to estimate the marginal external cost rather than starting with the total cost and then dividing it by the amount of traffic. This is particularly important in the case of congestion, accidents, and noise, for which there are important non-linearities.
4. The effects of moving to a more efficient pricing system are likely to be diverse, both because of differing circumstances between countries and because of different starting points. For instance, in some countries rail fares are held very low, whereas in others they are close to commercial levels. This makes it difficult to generalise about the effects of efficient pricing from a small number of case studies.
5. Further extension of deregulation and commercialisation may not necessarily benefit rail transport in terms of the relative level of price compared with other modes as - while the process has led to substantial reductions in terms of prices in road freight and air transport - it has tended to raise prices for bus and rail. The explanation is in terms of the very different starting points in terms of pricing policies and subsidies between the modes. However, recent trends may imply that significant scope remains for reductions in unit costs in the bus and rail industries.
6. The simple belief that a move to more efficient pricing would uniformly benefit the more environmentally friendly modes at the expense of other modes is also found to be not universally true. For instance, the current price of inter urban motoring is seen to be too high relative to 2010 marginal social cost. This gives little support for the introduction of additional charges on inter-urban roads except for specific cases of serious congestion or especially strong environmental effects. On the other hand, the case for urban road pricing in congested cities is reaffirmed. Similarly whilst there is generally a case for lower prices and increased traffic for public transport, in some cases existing subsidies are already excessive. Only in the urban case study is a substantial diversion of traffic to public transport justified.
7. In the case of road freight, the picture is mixed but generally there is under-charging of long distance road freight. This is partly a problem of the structure of the existing taxation system. Fuel taxes do not increase sufficiently with the weight (and particularly the axleweight) of the vehicle to reflect the marginal social cost of heavy vehicles. An annual charge over-charges low mileage vehicles and under-charges vehicles used intensively on long distance work. Even the vignette, as currently utilised, is related to time rather than distance run. Thus there is a clear case for reform of road freight vehicle taxation, to introduce a charge based both on vehicle characteristics and distance travelled.



<b>No.</b>	<b>Title</b>	<b>Availability</b>	<b>WP</b>	<b>Status*</b>	<b>Submission Date</b>
D1	<i>Review of Current Situation</i>	Public	1.1	A	February 1997
D2	<b>Pricing Principles</b>	Public	1.2	A	Aug 1998
	<i>Appendix</i>	Public		A	Nov 1997
D3	<i>Deregulation and Pricing</i>	Public	1.4	A	July 1997
D4	<i>Practical Pricing Problems</i>	Public	1.5	A	July 1997

<b>No.</b>	<b>Title</b>	<b>Availability</b>	<b>WP</b>	<b>Status*</b>	<b>Submission Date</b>
D7	<b>Internalisation of Externalities</b>	Public	1.3	A	Sept 1998
	<i>Appendix</i>	Public		A	Sept 1998
D9	<b>Cross Channel Case Study</b>	Public	2.2	A	July 1999
D10	<b>Transalpine Freight Case Study</b>	Public	2.3	A	July 1999
D11a	<b>Case Study - The Nordic Triangle within Finnish Borders</b>	Public	2.4	A	July 1999
D11b	<b>The Oslo – Gothenburg Case Study</b>	Public	2.4	A	July 1999
	<b>FINAL REPORT</b>	Public	-		8 December 2000

### **Notavegan tasks and participants**

The Institute of Transport Economics was leader of work package 1.3. In addition, the institute was responsible for the Oslo – Gothenburg Case Study.

Dr Farideh Ramjerdi participated in establishing the consortium but later moved to the KTH in Stockholm, Sweden. Peter Christensen contributed to the report from work package 1.3, “Internalisation of Externalities”. He wrote the introductory chapters and the chapter on the costs of global warming.

Inger Anne Sætermo began the work on the Oslo – Gothenburg Case Study. She also left the Institute. Most of the work on this case study was done by Randi Jule.



# TEST

## Technologies for European Surveys of Travel Behaviour (TEST)

### Information on the Project

**Project No:** 2299

**Commissioned by:** European Union (DG VII), 4<sup>th</sup> Framework Programme

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## Summary

### Objectives

This project was involved in developing innovative technologies to improve data collection, processing and dissemination for long distance travel surveys. The project concentrated on five areas considered to be very promising:

1. Using hand held computers as a tool for near real time data collection
2. Offering respondents Internet based forms for the completion of long distance travel surveys.
3. Using geographical information systems (GIS) to enrich travel diary data sets, in particular with respect to geocoding
4. Using artificial intelligence approaches to improve data imputation and error correction
5. Building a World Wide Web interface to disseminate survey results

### Main results and conclusions

The work demonstrated not only the feasibility of the approaches chosen, but also their long term potential:

- The hand held HPC based *travel diary application (TDA)* was shown to be acceptable under the conditions of small scale field tests in four countries. These trials were successful in gathering data on journeys.
- The www based *iTDA* was also a success in two countries, in spite of the current low speeds of the Internet. The overall system architecture with its newly developed specialised IITML tags opens new avenues for travel behaviour research.
- Existing sampling difficulties (in the case of the Portuguese tests: women, older respondents) limit the application of the *iTDA* at the moment but fast rising market penetration and greater familiarity across the population as a whole should reduce these problems in the near future.
- The *GIS based work* advanced knowledge about the required structure and size of place name databases and their sources substantially and provided a semi-automatic tool for geocoding of places and the derivation of shortest paths between places visited.

- The *AI based parsing system* developed makes the classical techniques of imputation available to transport research enriching them with logical checks for the standard variables and providing for the first time an audit trail for the data correction process.
- The *neural net* based work showed that self organising maps (SOM) can be a valid alternative to many classical imputation techniques, while also offering the possibility of detecting erroneous data.
- The *www based interface* to travel diary data demonstrated the usefulness of this open approach to data publication with a sophisticated web site built with free software tools, making it transferable to all interested parties.

### **Main reports, papers and articles**

#### **Deliverables**

- Elvas, C. and J. Viegas (1999) Assessment of the technologies, report to the CEC, DG VII, *TEST Deliverable, D7*, TIS, Lisbon.
- Fessant, F. and S. Midenet (1999) A knowledge-based parser: Neural-network-based approaches, report to CEC, DG VII, *TEST Deliverable, D5B*, INRETS, Arcueil.
- Haubold, I. and K.W. Axhausen (1999) A real-time recording system, report to the CEC, DG VII, *TEST Deliverable, D2*, Fakultät für Bauingenieurwesen und Architektur and Centre for Transport Studies, Innsbruck and London.
- Haubold, I., P. Jackson, K.W. Axhausen and J.W. Polak (1997) Technology assessment, report to the CEC, DG VII, *TEST Deliverable, D1*, Fakultät für Bauingenieurwesen und Architektur and Centre for Transport Studies, Innsbruck and London.
- Hubert, J.P., P.O. Flavigny and J.L. Madre (1999) Tools to enrich travel diary data sets, report to CEC, DG VII, *TEST Deliverable, D4*, INRETS, Arcueil.
- INRETS (1998) GIS-based enrichment of travel diary data sets, report to CEC, DG VII, *TEST Deliverable, D9*, INRETS, Arcueil.
- Lothaire, O. and P. Toint (1999) A knowledge-based parser: Implementation of a tool-box, report to CEC, DG VII, *TEST Deliverable, D5A*, GRT, FUNDP, Namur.
- Plaxton, J. and J.W. Polak (1999) A respondent support system, report to the CEC, DG VII, *TEST Deliverable, D3*, CTS, Imperial College, London.
- Reginster, I. (1998) A www-interface to travel diary results, report to CEC, DG VII, *TEST Deliverable, D6*, GRT, FUNDP, Namur.
- TEST Consortium (1999) Final recommendations, report to the CEC, DG VII, *TEST Deliverable, D8*, Fakultät für Bauingenieurwesen und Architektur, Innsbruck.

## **Working Papers**

- Denstadli, J.-M. and J.-I. Lian (1998) Memory effects in long distance travel surveys, *TEST Working Paper*, TOI, Oslo.
- Denstadli, J.-M. (1998) Non-response in travel surveys using CATI, *TEST Working Paper*, TOI, Oslo.
- Denstadli, J.-M. (1998) Analysing air travel: A comparison of different survey methods and data collection procedures, *TEST Working Paper*, TOI, Oslo.
- Fessant, F. and S. Midenet (1998) First experiences with a neural-net parser, *TEST Internal Working Paper*, **IWP11**, INRETS, Arcueil.
- Haubold, I. and K.W. Axhausen (1997a) Analysing the options, *TEST Internal Working Paper*, **IWP13**, Fakultät für Bauingenieurwesen und Architektur, Innsbruck.
- Haubold, I. and K.W. Axhausen (1997b) Initial design of the technologies, *TEST Internal Working Paper*, **IWP14**, Fakultät für Bauingenieurwesen und Architektur, Innsbruck.
- Haubold, I. and K.W. Axhausen (1998) First experiences with a real-time recording system, *TEST Internal Working Paper*, **IWP07**, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.
- INRETS (1997a) Design of a tool to enrich travel diary data sets, *TEST Internal Working Paper*, **IWP03**, INRETS, Arcueil.
- Midenet, S. and F. Fessant (1997) Design of a neural-net parser, *TEST Internal Working Paper*, **IWP05**, INRETS, Arcueil.
- Lindberg, K. (1998) Border surveys: State of the art, *TEST Working Paper*, TOI, Oslo.
- Lindberg, K. (1998) Method issues in road and airport surveys: Variation and coverage, *TEST Working Paper*, TOI, Oslo.
- Lothaire, O. and P. Toint (1997) Design of a knowledge-based parser, *TEST Internal Working Paper*, **IWP04**, FUNDP, Namur.
- Lothaire, O. and P. Toint (1997) First experiences with a knowledge-based parser, *TEST Internal Working Paper*, **IWP10**, FUNDP, Namur.
- Plaxton, J. and J.W. Polak (1997) Design of respondent support systems, *TEST Internal Working Paper*, **IWP02**, Centre for Transport Studies, Imperial College, London.
- Plaxton, J. and J.W. Polak (1998) First experiences with a respondent support system, *TEST Internal Working Paper*, **IWP08**, Centre for Transport Studies, Imperial College, London.
- Reginster, I. and P. Toint (1997) Design of a WWW-interface, *TEST Internal Working Paper*, **IWP06**, FUNDP, Namur.
- Reginster, I. and P. Toint (1997) First experiences with a WWW-interface, *TEST Internal Working Paper*, **IWP12**, FUNDP, Namur.
- TEST Consortium (1997) Proceedings, First TEST workshop, April 1997, Innsbruck, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.

TEST Consortium (1997) Proceedings, Second TEST workshop, June 1997, Innsbruck, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.

TEST Consortium (1998) Proceedings, Third MEST/TEST workshop, September 1998, Pörschach, Fakultät für Bauingenieurwesen und Architektur, Leopold-Franzens-Universität, Innsbruck.



# **Traffic safety**





## ESCAPE

# Enhanced Safety Coming from Appropriate Police Enforcement

### Information on the Project

**Project No:** RO-98-RS.3047

**Commissioned by:** Commission of the European Communities

**Lead partner:** Technical Research Centre of Finland (VTT)

**Partners:**

Bundesanstalt für Strassenwesen – BAST (D)

Institut National de la Recherche sur les Transport et leur Sécurité – INRETS (F)

Kuratorium für Verkehrssicherheit (Austria)

Institute for Road Safety Research – SWOV (NL)

The Institute of Traffic Planning and Traffic Engineering TUV-IVV (Austria)

Institute of Transport Economics – TØI (NO)

The University of groningen - RUG (NL)

Transport Research Laboratory – TRL (UK)

Swedish National Road and Transport Research Institute – VTI (S)

Aristotle University of Thessaloniki – AUTH (Greece)

Centrum Dopravního Výzkumu – CDV (CZ)

**Project manager at TØI:** Truls Vaa

## Summary

The aim of ESCAPE was to identify important areas of traffic and driver non-compliant behaviour and to assess the potential of enforcement tools, both traditional and innovative, to improve compliance and thus contribute to safety on European roads. ESCAPE sought to integrate existing information with results from new studies and analyses, and thus searching for new, innovative approaches to enforcement. For this purpose it:

- surveyed legal issues concerning enforcement in European countries, with emphasis on national differences and social acceptance of various enforcement survey strategies and methods,
- conceptualised alternative enforcement, monitoring, legal and administrative tools assessing their potential to reduce non-compliance and accidents,
- developed guidelines for monitoring non-compliant behaviour and assessing of the impacts of enforcement on road user behaviour, and on accidents,
- specified the most promising areas and enforcement tools, judged by accident reduction potential, near or mid term feasibility, social acceptance, and other criteria, so that they could be incorporated as demonstration projects in the 5<sup>th</sup> Framework Programme,
- consulted and co-operated with police, legal, administrative and other bodies and organisations involved in traffic enforcement in member countries, and thus encouraged them to look for new approaches and prepare the ground for testing of most promising new ideas.

More specifically, ESCAPE consolidated existing information as well as seeking to produce new data with respect to the following interrelated enforcement issues in Europe (the workpackages that dealt with each objective are in brackets):

1. What are the levels of non-compliance with traffic laws (WP2, WP5);
2. What is the contribution of non-compliance to accidents (WP2);
3. What new areas of non-compliance or enforcement issues emerged in Europe of the 90's (WP1, WP2);
4. How is enforcement carried out in practice in different countries (WP1, WP3, WP4);
5. What are the constraints for efficient enforcement, in different countries (WP1, WP3, WP4, WP5);
6. What role do non-police institutions and functions have in enforcement (WP3);
7. How can conventional enforcement be improved (WP1, WP3, WP4);
8. What alternatives to police enforcement are there (WP3);
9. What new tools and technologies for effective enforcement are there (WP4, WP1);
10. How will such tools be accepted by individuals, public, and institutions in different countries (WP1, WP5);
11. What areas of enforcement, and by which tools, appear to be cost effective (WP1);
12. How should non-compliance, and enforcement effectiveness, be monitored and assessed (WP6);

## Methods

ESCAPE utilised the many contacts to be made during the study with police agencies and other officials in several countries, in order to start creating the basis for new enforcement initiatives in Europe. Therefore, ESCAPE sought close contact with TISPOL (*Traffic Information Systems by the Police*) and other European bodies that have interest in enforcement or adjudication.

- Several surveys, literature reviews, workshops, database inquiries were conducted in the countries of ESCAPE partners on issues as: Enforcement needs on European roads, levels of non-compliant driver behaviour in ESCAPE countries, enforcement support systems in EU countries, non-police enforcement practices, automatic enforcement use and issues, new technologies and systems, driver and social perceptions of compliance and enforcement, police and other agencies
- Results from meta-analysis of the effects of relevant enforcement techniques on accidents were provided for the ESCAPE project
- Representatives of relevant user groups and experts were invited to workshop. It was expected that this strategy would benefit both the researchers and the practitioners, and thus help in dissemination and sharing of information and thus encourage adoption of more uniform principles of enforcement across Europe. A three-day workshop with relevant user groups, invited experts and researchers from ESCAPE was arranged in Nice in november 1999.
- In november 2000, a TISPOL conference was held in Amsterdam in joint cooperation with ESCAPE representatives from VTT, SVOW and BAST. Several papers from the ESCAPE project were presented at the TISPOL conference.

## Main deliverables and articles

- D1 Enforcement needs on European roads (P = Public)
- D2 Recommended enforcement projects for EU (P)
- D3 Targeting enforcement tools on critical violations (P)
- D4 Non-police based enforcement (P)
- D5 Legal and administrative support of enforcement (P)
- D6 New concepts in automatic enforcement (P)
- D7 Driver perceptions and experiences (P)
- D8 Survey of opinions of police & other agencies (P)
- D9 Recommendations for methods of assessing non-compliance and enforcement effectiveness (P)

### **Working papers:**

- Wp1: Evaluation of potential enforcement methods (WP1)
- Wp2: Documentation of enforcement workshops (WP1)

Wp3: Review of non-compliant behaviour and accidents (WP2)  
Wp4: Review of enforcement support systems in EU countries,  
Wp5: Workshops on acceptance of new Enforcement concepts (WP3)  
Wp6: Automatic enforcement use and its issues across EU-countries (WP4)  
Wp7: Automatic enforcement technologies and systems, (WP4)  
Wp8: Individual differences in attitudes to enforcement of traffic regulations, (WP5)  
Wp9: Results of agency workshop (WP5)  
Wp10: Review of Descriptive Variables for Evaluating Police Enforcement, (WP6)  
Wp11: Methodological Guidelines for Evaluating Police Enforcement Projects (WP6),  
Wp12: Assessment of different methods (WP6)  
Wp13: Workshop and recommendations (WP6)

**TØI contributions to ESCAPE (working papers)**

Truls Vaa: *Driver behaviour, traffic violations and aggression: The association with accidents* (TØI Working paper nr SM/1101/2000)  
Truls Vaa: *Effects of police enforcement measures on accidents and levels of injury* (TØI Working paper nr SM/1104/2000)  
Rune Elvik: *Cost-Benefit Analysis of Police Enforcement* (TØI Working paper nr SM/1116/2000)  
Truls Vaa: *Some comments on the definition of aggression and aggressive driving behaviour* (TØI Working paper nr SM/1192/2000)

**Papers and conference presentations:**

Veli-Pekka Kallberg, Lille, October 9, 1999, European Transport Research Conference, Presentation of Project ESCAPE  
Panos Papaioannou, 4th International Conference Global Safety, Traffic Violations and Risk Perception in Greece  
Rainer Christ, IRTAD Seminar, Vienna, September 2000, Implementation of ESCAPE (?)  
Rainer Christ, Beshleuning ohne Grenzen? - Probleme, Konzepte, Visionen, Vienna, October 10, 2000, Tempüberwachung best practice - Ergebnisse aus dem ESCAPE Programm  
Christhard Gelau, Dreilaendertagung (Three-countries-conference), Evaluation of police enforcement  
Truls Vaa, Pretoria, September 20-22, 2000, Traffic Safety on Three Continents, Some comments on the definition of aggression and aggressive driving behaviour  
Victoria Gitelman, Shalom Hakkert & Christhard Gelau, (2000). Monitoring Police Enforcement: Synthesis of Guidelines. Paper presented at the International Conference "Road Safety on Three Continents", Pretoria, 20 - 22 September 2000.

- Gelau, C. & Pfeiffer, M. (in press). Methoden für die Evaluation von Maßnahmen der polizeilichen Überwachung. Manuscript accepted for publication by the "Zeitschrift für Verkehrssicherheit".
- Christhard Gelau, (2000). Monitoring traffic behaviour and traffic enforcement. Paper presented at the TISPOL European Conference am 10./11. Nov. 2000 in Amsterdam.
- Jelle Heidstra, Charles Goldenbeld and Meine van Essen, Evaluation study of a 4-year police enforcement intensification programme in the Netherlands, paper presented at 13<sup>th</sup> ICTCT workshop on Corfu, Greece, October 5-6, 2000.
- Peter Fischer, Evaluating Enforcement – Methodological Guidelines, paper presented at 13<sup>th</sup> ICTCT workshop on Corfu, Greece, October 5-6, 2000.
- David M. Zaidel, Ergonomic versus Psychological Perspective on Traffic Law Enforcement (based in part on ESCAPE experience), Presented at the ICTTP , 4-7 September, Berne, Switzerland.
- Tapani Mäkinen: Presentation of the results of the ESCAPE work group. The TISPOL European Conference, Amsterdam 10 & 11 november 2000.
- Charles Goldenbeld: Automatic traffic enforcement methods. The TISPOL European Conference, Amsterdam 10 & 11 november 2000.
- Christard Gelau: Monitoring traffic behaviour and traffic enforcement. The TISPOL European Conference, Amsterdam 10 & 11 november 2000.

# GADGET

## **Guarding Automobile Drivers through Guidance, Education and Technology**

### **Information on the Project**

**Project No:** RO-97-SC.2235

**Commissioned by:** European Commission, Transport RTD Programme of the 4<sup>th</sup> Framework Programme

**Lead partner:**

Kuratorium für Verkehrssicherheit (Austria)

**Partners:**

Bundesanstalt für Strassenwesen – BAST (D)

Institute of Transport Economics – TØI (NO)

Schweizerische Beratungsstelle für Unfallsverhütung – BfU (CH)

Institut National de la Recherche sur les Transport et leur Sécurité – INRETS (F)

Technical Research Centre of Finland - VTT (FIN)

University of Turku (FIN)

Swedish National Road and Transport Research Institute – VTI (S)

Transport Research Laboratory – TRL (UK)

Laboratorio Nacional de Engenharia Civil – LNEC (P)

Danish Council of Road Safety Research – RfT (DK)

Centrum Dopravního Výzkumu – CDV (CZ)

University Paris X (F)

Institute for Road Safety Research – SWOV (NL)

Trinity College (IRL)

Dirección General de Tráfico (E)

Technion – Israel Institute of Technology (IL)

**Project manager at TØI:** Fridulv Sagberg

## **Summary**

The general objective was to assess changes in driver behaviour resulting from the introduction of in-vehicle safety devices, visual modification of the road environment, educational, training and legal measures, and safety campaigns.

More specific objectives included to

- list all known traffic safety measures that target driver behaviour,
- list all known evaluation studies of behavioural effects of these measures and describe the results,
- develop a theoretical background for conceptualising the behavioural effects,
- provide an interpretation of the results of evaluation studies on the basis of the theoretical background, and
- describe research strategies and research needs.

The project was subdivided into five thematic workpackages, with reference to the general objective, covering the following categories of safety measures:

- Telematics and in-car safety equipment
- Visual modification of the road environment
- Driver education and training
- Legal measures and enforcement
- Safety campaigns

GADGET was a cluster of relatively autonomous projects (the five thematic workpackages) rather than one comprehensive project. Consequently, the relative emphasis on the various objectives differed somewhat between the workpackages; and in addition some additional objectives were specific to each workpackage.

The following methodological approaches were used in the project – varying somewhat between the workpackages.

- Literature surveys. All workpackages aimed at presenting a broad coverage of the relevant research literature – theoretical as well as empirical work - within their respective topics.
- Meta-analyses of safety measures satisfying the methodological requirements for such analyses.
- Expert judgements of behavioural effects of safety measures.

- Development of an evaluation guide for in-vehicle safety devices, and application of the guide to assess safety aspects of eight selected driver assistant systems.
- Recommendations for best practices concerning certain aspects of road design, signs, markings and signals as well as specific consideration of measures for increased safety in reduced visibility conditions.

- Development of a hierarchical model for the assessment of driver training and education, and presentation of recommendations for best practice regarding driver training systems.
- On the basis of meta-analyses of safety campaigns it was established that campaigns may have positive effects on driver behaviour and may reduce accidents under certain conditions.
- Regarding legal systems and enforcement, preconditions for increased seat belt use, decreased drunk driving, decreased speeding, and better safety among young drivers were pointed out, on the basis of research literature and a survey of European practices.
- For several safety measures there is a need for more behavioural research, in order to understand and predict the safety effects of single measures as well as various combinations of measures. Certain combinations of measures are considered efficient on the basis of theoretic interpretations, but more empirical data are needed.

### **Main reports, papers and articles**

#### **Project deliverables**

- Christ, R., Delhomme, P., Kaba, A., Mäkinen, T., Sagberg, F., Schulze, H., Siegrist, S. (1999) GADGET Final report. Investigations on influences upon driver behaviour – safety approaches in comparison and combination. Vienna: Kuratorium für Verkehrssicherheit.
- Delhomme, P., Vaa, T., Meyer, T., Harland, G., Goldenbeld, C., Järmark, S., Rehnova, V. (1999). Evaluated road safety media campaigns: An overview of 265 evaluated campaigns and some meta-analyses on accidents. GADGET Deliverable 4. Paris: INRETS.
- Mäkinen, T., Biccheler-Fretel, M.-B., Cardoso, J., Goldenbeld, C., Fuller, R., Hakkert, S., Jayet, M.-C., Martin, F. Sanchez, Skladana, P., Vaa, T., Zaidel, D. (1999). GADGET Wp-5 report. Legal measures and enforcement. Espoo: VTI.
- Sagberg, F., Hakkert, A.S., Larsen, L., Leden, L., Schmotzer, C., Wouters, P.I.J. (1999). Visual modification of the road environment. Deliverable D2 from the GADGET project. TØI Working Report 1137/99. Oslo: Institute of Transport Economics.
- Schulze, H., Christ, R., Heijer, T., Mäkinen, T., Nilsson, L. (1999). In-vehicle safety devices. GADGET Workpackage Report. Bergisch-Gladbach: BAST.
- Siegrist, S. (Ed.) (1999). Driver training, testing and licensing – towards theory-based management of young drivers' injury risk in road traffic. Results of EU project GADGET, Workpackage 3. Bfu Report 40. Berne: Schweizerische Beratungsstelle für Unfallsverhütung.

#### **Other dissemination**

- Christ, R. The GADGET project. Paper presented at 2<sup>nd</sup> European Road Research Conference, Brussels 7-9 June, 1999.



Sagberg, F. GADGET: Influencing driver behaviour in reduced visibility by modifying the visual road environment. Paper presented at 2<sup>nd</sup> European Road Research Conference, Brussels 7-9 June, 1999.

Sagberg, F. Visual modification of the road environment. Presentation at Nordic Seminar on Road Design, Trondheim 21-22 March 1999.

Vaa, T. (2000). Trafikksikkerhetskampanjer og virkning på trafikkulykkene: Resultater fra GADGET. Foredrag ved konferansen "Trafikksikkerhetsfokus 2000", Kristiansund, 29. august 2000.

NB! Further information about GADGET is available on the project homepage <http://www.kfv.or.at/gadget/>.

